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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* THOMAS R. BIELER,  
K. N. SUBRAMANIAN, and SUNGLAK CHOI

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Appeal 2009-006173  
Application 10/730,398  
Technology Center 1700

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Decided: April 29, 2010

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Before CHUNG K. PAK, CHARLES F. WARREN, and  
TERRY J. OWENS, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 20-62 in the Office Action mailed July 16, 2007. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 41.31(a) (2007).

We reverse the decision of the Primary Examiner.

Claims 20 and 54 illustrates Appellants' invention of a method for producing an in-situ composite solder having an intermetallic component, and are representative of the claims on appeal:

20. A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:

(a) providing a mixture comprising the components of a eutectic or near-eutectic matrix solder and the components of an intermetallic component present at greater than or equal to about 10 volume % and less than or equal to about 95 volume %, wherein said intermetallic component is selected to have a density within 10% of a density of said eutectic or near-eutectic matrix solder;

(b) heating said mixture so as to melt all components of said mixture forming a non-solid mixture; and

(c) cooling said non-solid mixture at a rate sufficiently fast so as to form said intermetallic components having a particle size of less than about 10 microns, wherein said intermetallic components are homogenously distributed throughout said matrix solder to form the composite solder.

54. A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:

(a) providing a binary or ternary eutectic or near eutectic matrix solder;

(b) heating a mixture of said matrix solder with the components of an intermetallic component comprising a first row transition metal, at a temperature greater than the highest melting temperature of all of the individual components of said mixture so as to form a non-solid mixture;

(c) rapidly cooling said non-solid mixture; wherein said composite solder comprises about 10 to about 40% by volume of said intermetallic component, said intermetallic component comprises at least one element present in said matrix solder; said intermetallic component comprises particles having a particle size of less than about 10 microns homogenously distributed throughout said composite solder, and said intermetallic component is selected to have a density within 10% of a density of said matrix solder;

(d) heating said composite solder to a temperature that is greater than a melting point of said matrix solder and less than a melting point of said intermetallic component, wherein said heating melts only said matrix solder; and

(e) cooling and solidifying said composite solder to form a solder joint, wherein said composite solder has a greater solder joint strength, creep resistance, and fatigue resistance than a comparative solder joint formed from a eutectic or near-eutectic solder.

The Examiner relies upon the evidence in these references (Ans. 3):

Lucey	5,520,752	May 28, 1996
Anderson (Anderson '628)	5,527,628	Jun. 18, 1996

A.W. Gibson, S.L. Choi, K.N. Subramanian, T.R. Bieler (Gibson), "Issues Regarding Microstructure Coarsening Due To Aging of Eutectic Tin-Silver Solder," Des. Reliab. Solders and Solder Interconnect., Proc. Symp., pp. 97-103 (1997).

Appellants rely upon the evidence in these references in rebuttal:<sup>1</sup>

I.E. Anderson, B.A. Cook, J. Harringa, R.L. Terpstra (Anderson), "Microstructural Modification and Properties of Sn-Ag-Cu Solder Joints Induced by Alloying," Journal of Electronic Materials, Vol. 31, no. 11 (2002).

E.A. Brandes and G.B. Brook (Brandes), Smithells Metals Reference Book pp. 11-242 (Butterworth Heinemann, 1992).

C.M. Miller, I.E. Anderson, J.F. Smith (Miller), "A Viable Tin-Lead Solder Substitute: Sn-Ag-Cu," Journal of Electronic Materials, Vol. 23, no. 7 (1994).

K.-W. Moon, W.J. Boettinger, U.R. Kattner, F.S. Biancaniello, C.A. Handwerker (Moon), "Experimental and Thermodynamic Assessment of Sn-

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<sup>1</sup> Miller and Moon are cited in Appellant Bieler's Declaration Under 37 C.F.R. § 1.132 executed November 19, 2006 (Bieler Declaration), and filed December 12, 2006. Anderson and Brandes were submitted with the Information Disclosure Statement filed December 12, 2006, and relied on in the Amendments filed April 9, 2007. Brandes is cited in the Specification. Spec. 10:23-25.

Ag-Cu Solder Alloys,” Journal of Electronic Materials, Vol. 29, no. 10 (2000).

Appellants request review of the grounds of rejection under 35 U.S.C. § 103(a) advanced on appeal by the Examiner: claims 20-24, 27-33, 36, 37, 39-45, 47-53, 55-59, and 62 over Anderson ‘628; claims 25, 26, 38, 46, and 61 over Anderson ‘628 in view of Lucey; and claims 34, 35, 54, and 60 over Anderson ‘628 in view of Gibson. App. Br. 7; Ans. 5, 6, and 7.

### Opinion

We have thoroughly reviewed the respective positions advanced by Appellants and the Examiner. In so doing, we concur with Appellants that the Examiner has failed to establish a prima facie case of obviousness for the claimed subject matter. Accordingly, we will not sustain the Examiner’s rejections.

The dispositive issue in this appeal is whether the prior art relied on by the Examiner teaches the following steps in the respective methods for producing an *in-situ* composite solder having an intermetallic component encompassed by representative independent claims 20 and 54: “(b) heating said mixture so as to *melt all components* of said mixture *forming a non-solid mixture*,” and “(b) heating a mixture of said matrix solder with the components of an intermetallic component comprising a first row transition metal, at a *temperature greater than the highest melting temperature of all of the individual components* of said mixture so as to *form a non-solid mixture*” (claims 20 and 54; emphasis supplied).

In giving the claim terms the broadest reasonable interpretation in their ordinary usage in context as they would be understood by one of ordinary skill in the art in light of the written description in the

Specification, we find Appellants disclose melting all of the components of the mixture to form a non-solid mixture. Spec., e.g., 6:11-12 (“heating the mixture until all of the individual components are melted (non-solid)”; 7:9-11 (mixture of Sn/Ag solder, Cu and Sn “heated to a temperature greater than the highest melting point of the constituent materials such that all components exist as liquids”); and 10:3-18 (mixture of Sn/Ag solder and components for Cu<sub>6</sub>Sn<sub>5</sub> intermetallic component “heated to a temperature that is greater than the highest melting temperature of the individual components,” wherein “pure Cu” has the highest melting point at 1085°C). See App. Br. 3:1-3 and 5:6-9.

Accordingly, on this record, we agree with Appellants that contrary to the Examiner’s position, the subject claim language specifies melting all components of the mixture to form a non-solid mixture, which necessarily includes heating to a temperature greater than that of the highest melting temperature component. App. Br., e.g., 16 and 17; Ans., e.g., 10. See, e.g., *In re ICON Health and Fitness, Inc.*, 496 F.3d 1374, 1378-79 (Fed. Cir. 2007); *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004), and cases cited therein; *In re Morris*, 127 F.3d 1048, 1054-55 (Fed. Cir. 1997).

Turning now to the prior art, we initially note that there is no dispute that, as Appellant Bieler attests, Moon establishes that “the ternary eutectic composition for the Sn-Ag-Cu system [of Anderson ‘628] is 3.5 wt.% Ag – 0.9 wt.% Cu – 95.6 wt. % Sn, with a eutectic temperature of approximately 217°C,” and not the “composition of 93.6 Sn – 4.7 Ag – 1.7 Cu (wt.%)” “having a eutectic point of about 217°C” as disclosed by Anderson ‘628 and

by Miller. Bieler Decl. ¶¶ 4-6, citing Miller, abstract, 598, col. 1 to 599, col. 1, and Moon 1122-23. *See* Anderson '628, e.g., col. 2, ll. 43-46. *See* App. Br., e.g., 8-11; Ans., e.g., 7-8. We find Moon discloses "[t]he present results indicate the eutectic composition to be 3.5 wt.% Ag  $\pm$  0.3 wt.% Ag and 0.9 wt.% Cu  $\pm$  0.2 wt.% at 217.2 °C  $\pm$  0.2 °C." Moon 1133. There is also no dispute that Anderson does not challenge Moon's results. Anderson, e.g., 1166-67. *See* App. Br., e.g., 8-11; Ans., e.g., 7-8.

We agree with the Examiner's finding that Anderson '628 nonetheless would have disclosed to one of ordinary skill in this art "near-eutectic" Sn-Ag-Cu solder compositions. Ans. 7-8, citing Anderson '628 col. 2, ll. 60-64. We find Anderson '628 discloses preferred "near eutectic" solder compositions that consist essentially of about 3.5 to about 7.7 wt.% Ag, about 1.0 to about 4.0 wt.% Cu, and the balance essentially Sn, as illustrated by three compositions: 93.6 wt.% Sn – 4.7 wt.% Ag – 1.7 wt.% Cu, 94.9 wt.% Sn – 3.6 wt.% Ag – 1.5 wt.% Cu, and 95.0 wt.% Sn – 4.1 wt.% Ag – 0.9 wt.% Cu. Anderson '628, e.g., col. 2, ll. 46-52 and 60-64, and col. 4, l. 54 to col. 5, l. 31.

On this record, we cannot agree with Appellants' position that Anderson '628 is not an applicable reference because of the disclosure of a particular "eutectic" Sn-Ag-Cu solder composition later shown to be erroneous. App. Br., e.g., 8-15; Reply Br. 5-11. Indeed, the preferred "near-eutectic" Sn-Ag-Cu solder compositions disclosed by Anderson '628 encompass not only the eutectic Sn-Ag-Cu solder composition described by Moon but also the Sn-Ag-Cu solder composition erroneously described by Anderson '628 as "eutectic." Thus, we are of the opinion that the facts in

the record before us establish that Anderson '628 would have disclosed Sn-Ag-Cu solder compositions that would have been prepared by one of ordinary skill in this art, the error in the "eutectic" composition notwithstanding. Indeed, Appellants acknowledge that "ternary eutectic" Sn-Ag-Cu solder compositions are disclosed by Anderson '628. Accordingly, the facts of record distinguish *In re Yale*, 434 F.2d 666, 668-69 (CCPA 1970) (listing of a compound in reference would have been apparent typographical error to one of ordinary skill in the art, and thus would not have described or suggested the compound to that person so as to place it within his/her possession).

However, whether Anderson '628 would have further disclosed to one of ordinary skill in this a method for producing an in-situ composite solder having an intermetallic component comprising at least, among other things, the step of melting all components of the mixture to form a non-solid mixture, as encompassed by representative independent claims 20 and 54, is another matter. *See above* pp. 4-5. In this respect, we agree with Appellants that, at most, Anderson '628 "merely describes heating the solder to a melt pour temperature of about 300°C" which "is insufficient to fully melt," among other things, Cu. App. Br. 17, citing Anderson '628 col. 6, l. 32. *See* Anderson '628 col. 6, ll. 16-33. There is also no dispute that Lucey and Gibson do not disclose heating a solder composition to melt all of the ingredients. App. Br., e.g., 16 and 17, citing Lucey, e.g., col. 2, ll. 12-16, and col. 3, ll. 35-40; Ans. 9-10. Indeed, the Examiner finds that Anderson and Gibson "teach to melt solder with components as claimed

below 300°C.” Ans. 9-10, citing Anderson ‘628 col. 6, ll. 3-12, and Gibson Fig. 2.

Accordingly, on this record, we are of the opinion that Appellants arguments establish that the evidence in the totality of the record weighs in favor of the nonobviousness of the claimed method for producing an in-situ composite solder having an intermetallic component, including the step of melting all components of the mixture to form a non-solid mixture, encompassed by appealed claims 20-62. Thus, we reverse the grounds of rejection of appealed claims 20-62 under 35 U.S.C. § 103(a).

The Primary Examiner’s decision is reversed.

REVERSED

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